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Preliminary Results - Surface Geophysical Survey

ARCS - Albion Sheridan Township Landfill Site

Albion, Michigan

04011.02

SHALLOW ELECTROMAGNETIC SURVEY

A shallow electromagnetic (EM) survey was run over the main landfill site and adjacent property to the west. A Geonics EM31 conductivity meter was used to simultaneously measure terrain conductivity (quadrature phase instrument response) to a maximum depth of about 18 feet and the in-phase instrument response (primarily an indicator of metal). These data were collected continuously along east-west traverse lines spaced 50 feet apart. Figure 1 shows the EM31 traverse line locations.

The quadrature and in-phase data were gridded and contoured (Figures 2 and 3, respectively). Several anomalies to the north and south that are attributable to surface debris are indicated. The distribution of the bulk of anomalies in both data sets indicates that, with the exception of those areas not surveyed, the landfill boundaries can be delineated. In general, the anomalies are numerous, variable in magnitude and suggestive of buried conductive debris such as metal. One unusually large anomaly is seen in the northern portion of the site (quadrature phase data between lines 6350 and 6550 North). It is reasonable to suspect that this anomaly may be related to metallic sludge disposal activities that site background information indicates occurred at the site.

The quadrature and in-phase data recorded along each EM31 profile line were also plotted. Figures 4, 5 and 6 provide selected examples of data over areas where anomalies were not detected (areas not landfilled - lines 6650 and 6600) and over areas where anomalies were detected (landfilled areas adjacent to unfilled areas - lines 5350 through 5550 and line 6400). Quadrature phase measurements over the suspected metallic sludge fill area to the north are as high as 130 mmhos/meter over a distance of about 230 feet along line 6400 (Figure 6). The landfill boundaries as indicated along individual traverse lines are plotted on Figure 1.

It should be noted that a number of anomalies observed along the eastern site boundary may be related to extensive surface debris observed between lines 5800 and 6150N and east of station 4800E.

INTERMEDIATE DEPTH ELECTROMAGNETIC SURVEY

An intermediate depth EM survey was run over the main landfill site and property adjacent to the west and south. A Geonics EM34 conductivity meter was used to measure terrain conductivity (quadrature phase component) to a maximum depth of about 50 feet. Data were collected semi-continuously along traverse lines spaced 200 feet apart over the western parcel and along selected lines south of and within the main landfill area, as accessible.

The primary objective of the intermediate depth survey was to screen areas adjacent to the landfill for a ground water contaminant plume. The survey focused on the areas to the west and south as shallow ground water was suspected to flow south-southwest. Additional lines were run north of the landfill and over the landfill itself, as determined using the EM31 survey results.

EM34 data from line 6800, located north of the landfill (presumably upgradient), indicates that deeper terrain conductivity averages 2 to 3 mmhos/meter. Conductivity values measured in unfilled areas west of the site increase to the south. Values observed at the south end of the traverse line run along station 3650E average 7 mmhos/m (Figure 7). South of the main site, conductivities in unfilled areas average 9 mmhos/meter (line 4500N; Figure 8).

EM34 data collected over the area west of the site was gridded and contoured (Figure 9). Conductivities greater than about 5 mmhos/meter were measured over a somewhat southwesterly trending area as seen in this figure. This subtle trend could be associated with topographic effects and proximity to fill material, in general. However, if water level data collected during the subsequent investigation indicate that ground water flow correlates with this trend, the sampling plan should provide for well installation and ground water sampling in the area of higher terrain conductivity.

VERTICAL ELECTRICAL SOUNDINGS

Two vertical electrical soundings (VES's) were performed at the Albion-Sheridan Landfill. VES 1 was located in the landfill at coordinates 5790N 4575E with an electrode array orientation of 315 degrees west of north; Ves 2 was located along the western margin of the landfill at coordinates 5810N, 3650E. VES 2 electrode array was oriented in a north-south direction.

Both VES's were completed using Abem Terrameter Resistivity Sounding equipment. The Schlumberger electrode array was used in order to reduce the effects of lateral variations in geology on the measurement of apparent resistivity. Current electrode spacings were based on a logarithmic scale with 6 spacings per decade. The distance between current electrodes (MN spacing) was kept below 40% of AB/2 (1/2 the distance between current electrodes). Resistivity readings were collected as the current electrodes were expanded from an initial distance of 1 meter from the center of the array, to the maximum AB/2 distance of 100 meters. After a number of current electrode expansions, the MN spacing was expanded by one increment, while AB/2 was held constant, to increase the sensitivity of the instrument and to provide a check as to the validity of the measurement.

INTERPRETATION

Resistivity data were interpreted using the Interpex software package RESIXP. Both forward and inverse modeling were employed, with the final model also evaluated for equivalence. Geologic control during modeling was provided by information on the depth to bedrock obtained from well logs of residential wells in the vicinity.

Although modeled with 5 layers, the data curve generated from VES 1 is indicative of a 3-layer case (Figure 10). Two thin layers (a conductor and a resistor) were added to the model near the surface to provide a better fit of the model curve with respect to the observed (data) curve. The observed data curve was difficult to fit because of the variation of apparent resistivity values, probably due to lateral changes in geology and hence resistivity. The basic assumption of an earth consisting of homogeneous layers separated by horizontal plane interfaces is likely to be invalid within a landfill. The subsequent distortion of current lines by changes in geology and the potential presence of subsurface conductors may preclude the measurement of apparent resistivities which when graphed would be similar in shape to theoretical or modeled curves

The resistive surface layer and the two additional layers can be grouped together to form one resistive layer approximately 5 to 8 feet thick. This layer is underlain by a 25 to 30 foot thick layer of low resistivity (30 ohm-meters). The low resistivity values are likely due to the presence of conductive fill material. The sandstone bedrock is modeled as being approximately in the range of 33 to 37 feet below the ground surface with a resistivity of 120 ohm-meters.

VES 2 is a four layer curve (Figure 11). The top two layers are a resistor and a conductor. They are likely underlain by a relatively thick layer, of very resistive sand and gravel (2000 plus ohm-meters). The bedrock at this location is interpreted to be approximately 35 to 40 feet below the ground surface. The resistivity of the bedrock is in the range of 180 ohm-meters.